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Origins of Chinook Salmon in the Yukon River Fisheries, 2007

by

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Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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ABSTRACT

The stock and age composition of all harvests of Chinook salmon *Oncorhynchus tshawytscha* within the Yukon River drainage, by district, fishery, and country, was estimated in 2007. Stock composition was estimated for 3 geographically-based stock groups termed Lower, Middle, and Upper. Age composition was estimated from scales collected in each respective harvest or from similar harvests. Genetic stock identification was used to estimate harvest stock composition by fishery in Districts 1 through 5. District 6, Canadian, and portions of District 5 subsistence harvests were assigned to stock group based on geographic location. The total estimated Yukon River harvest in 2007 was 94,649 Chinook salmon; of those, 13.0% were estimated to be of Lower, 30.6% Middle and 56.4% Upper Yukon River origin. Harvest by major age classes was 60.0% age-6, 26.5% age-5, and 11.0% age-4 fish.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, Yukon River, stock composition, age composition, commercial harvest, subsistence harvest, genetic stock identification, Canadian harvest, stock groups

INTRODUCTION

The United States (U.S.) and Canada have been engaged in cooperative management and conservation of salmon stocks spawning in Canada since 1985 when a Memorandum of Understanding was incorporated into the Pacific Salmon Treaty. In 2002, the Yukon River Salmon Agreement was signed as part of the Treaty, whereby the U.S. and Canada agreed to harvest sharing of Chinook salmon *Oncorhynchus tshawytscha* that migrate through Alaskan waters and spawn in the Yukon Territory and British Columbia. Stock composition estimates of Alaskan harvests provide valuable information for management and conservation of Chinook salmon throughout the Yukon River drainage, and aid in fulfillment of Treaty objectives.

The Yukon River drains roughly 330,000 square miles, originates in northern British Columbia, and flows over 2,300 river miles (rm) to the Bering Sea (Hayes et al. 2008). Chinook salmon spawn in major tributaries throughout the drainage. Yukon River Chinook salmon are harvested annually in various fisheries in both marine and fresh waters. Within the Yukon River, returning adult salmon are harvested in subsistence and personal use fisheries in Alaska, aboriginal and domestic fisheries in Canada, and commercial, test, and sport fisheries in Alaska and Canada (Figures 1 and 2). Commercial salmon fishing in Alaska is allowed along the entire 1,231 rm of the mainstem Yukon River and the lower 225 rm of the Tanana River. The Yukon River Management Area, Alaska, is divided into districts and subdistricts for management and regulatory purposes (Figure 1). Commercially sold Chinook salmon harvests consist of fish sold in the round and fish harvested by the Alaska Department of Fish and Game (ADF&G) in test fishery projects. However, in recent years fish caught in test fisheries have been donated to local subsistence users. Sport fisheries primarily occur in lower river tributaries, Tanana River tributaries, and in Canada. The average annual harvest of Chinook salmon within the Yukon River drainage from 1997 to 2006 was 105,782 fish. Of these, approximately 90% were harvested in Alaska (JTC 2008).

Although more than 100 spawning streams have been documented (Barton 1984), aerial surveys of Chinook salmon escapements have indicated that the largest concentrations of spawning salmon occur in tributary groupings in 3 distinct geographic regions: 1) Alaskan tributary streams draining the Andreafsky Hills and Kaltag Mountains (rm 100–500); 2) Alaskan tributary streams in the upper Koyukuk River and Tanana River basins (rm 800–1,100); and 3) Canadian tributary streams draining the Pelly and Big Salmon mountains (rm 1,300–1,800) (Merritt et al. 1988; Hayes et al. 2008). Initially, McBride and Marshall (1983) termed Chinook salmon stocks within these geographic regions “runs” but Lingnau and Bromaghin (1999) reclassified them as

Lower, Middle, and Upper Yukon River stock groups. The Lower stock group includes Alaskan tributary streams from the Andreafsky River to near the confluence with the Tanana River, including the lower Koyukuk River drainage. The Middle stock group includes Alaskan tributary streams upstream from the Tanana River confluence, and the upper Koyukuk and Tanana river drainages. The Upper stock group is Canadian-origin fish.

From 1981 through 2003, stock composition of Yukon River drainage Chinook salmon harvests was estimated using scale pattern analysis (e.g., DuBois 2005). In 1997, a panel convened by the U.S. and Canadian Joint Technical Committee (JTC) determined that scale pattern analysis provided sufficient stock-specific information for management and research pending the development of improved genetic stock identification capabilities (Schneiderhan 1997). Based on surveys of genetic variation among Chinook salmon populations in the Yukon River drainage, a baseline of genetic information was completed and used for genetic stock identification using allozyme loci (Beacham et al. 1989; Wilmot et al. 1992; Templin et al. 2005). Then, in 2003 a survey of single nucleotide polymorphisms (SNPs) in Yukon River Chinook salmon demonstrated that stock identification information could be obtained in an accurate and efficient manner using newly developed genetic methods (Smith et al. 2005). In 2006, the stock composition of Yukon River fishery harvests was estimated using mixed stock analysis based on 26 SNPs markers (Templin et al. 2006a); this analysis was again utilized for 2007 (DeCovich and Templin 2009).

OBJECTIVE

The goal of this project is to estimate the Yukon River Chinook salmon harvest by stock (i.e., geographic region) and age class during the 2007 season. This report apportions annual harvests to Lower, Middle, and Upper stock groups based upon on the 26 SNPs marker baseline and provides estimates by age class, district, and fishery.

METHODS

SCALE COLLECTION, PROCESSING, AND AGING

Chinook salmon were sampled for age from commercial, subsistence, and test fisheries and escapements within the Yukon River drainage. Scales were removed from the preferred area of the fish for age determination and mounted on gum cards (INFPC 1963). Three scales were collected from each fish to allow for the incidence of scales that cannot be aged. Scales were impressed in cellulose acetate using methods described by Clutter and Whitesel (1956); impressions were magnified and examined in a Microfiche reader. Age was determined by counting the number of freshwater and marine annuli, the regions of the scale where the circuli, or rings, are tightly spaced, and represent slower growth rates associated with winter conditions (Mosher 1969). Ages were recorded using European notation; number of freshwater annuli separated by a decimal from number of marine annuli. Total age from the brood year is the sum of freshwater and marine annuli plus 1 to account for time spent in the gravel before hatching. ADF&G staff processed the Alaskan age data and Horne-Brine et al. (2009) provides age composition summaries from selected projects within the Yukon River drainage.

GENETIC COLLECTION, PROCESSING AND ANALYSIS

Chinook salmon were sampled over the course of the run from test, commercial, and subsistence fisheries. Tissue samples for genetic analyses were collected during each fishing period usually

concurrent with age collections (DuBois et al. 2009). One axillary process was removed from each fish and put into an individually numbered vial, or into a bulk sample bottle, filled with denatured ethanol. These tissues were shipped to the ADF&G Gene Conservation Laboratory for processing. Stock composition estimates for 3 broad scale stock groups (Lower, Middle and Upper) were generated using the program SPAM, version 3.7 (Debevec et al. 2000). The desired accuracy and precision objectives were a 90% confidence interval with a width of approximately 10%. DeCovich and Templin (2009) describe laboratory methods used to estimate stock composition for the 2007 harvest samples.

U.S. HARVEST BY AGE AND STOCK

Harvest sampling for age and genetic data from specific locations and fisheries were used to estimate age and stock composition from these harvests. Age and stock composition of harvests not sampled were estimated from other samples that were presumed to be similar. These may be from an adjacent harvest or from a mixture of test, commercial, subsistence, or escapement data.

For each harvest the number of fish per stock group and age class was estimated as follows.

Denote,

$N_{d,i,j}$: The number of salmon at *d-th* harvest group, *i-th* stock and *j-th* age;

$N_{d,k}$: The number of salmon (e.g., commercial, subsistence harvest) at *d-th* harvest group and *k-th* period;

$Ps_{,d,i,k}$: Proportion of *i-th* stock at *d-th* harvest group and *k-th* period;

$Pa_{,d,j,k}$: Proportion of *j-th* age at *d-th* harvest group and *k-th* period.

The estimated harvest by harvest group, stock, and age-class is then,

$$\hat{N}_{dij} = \sum_{k} (\hat{N}_{d,k} \cdot \hat{P}s_{d,i,k} \cdot \hat{P}a_{d,j,k}) .$$

These calculations were used for each harvest group throughout the drainage. Commercial harvests by period and subsistence harvests by village were summed to obtain district-wide estimates by stock and age class.

Commercial

The majority of the commercial harvests were sampled to estimate the age and stock composition from each respective harvest. There were 3 commercial periods in District 1 (periods 1, 3, and 5) and 3 in District 2 (also periods 1, 3, and 5) which allowed unrestricted mesh where any mesh size gillnet within regulation could be used. The other periods were restricted to ≤6 inch mesh to conserve Chinook salmon and target chum salmon. ADF&G crews sampled Chinook salmon from 9 of 12 commercial periods in District 1 and 5 of 9 periods in District 2 (Tables 1 and 2). The sampling goal for each unrestricted mesh period was 400 fish and from each restricted mesh period was 200 fish. All District 1 and 2 harvest samples included age and genetic data from each fish.

Age and stock estimates from Chinook salmon sampled in periods 1, 3, 4, 5, 6, 7, and 8 in District 1 were directly applied to each respective harvest. Periods 2, 11, and 12 were not

sampled in District 1. Period 4 was used for period 2 age and stock estimates. Periods 9 and 10 were combined to estimate harvest composition from periods 9 to 12.

Age and stock estimates from Chinook salmon sampled in periods 1, 2, 3, and 5 in District 2 were directly applied to each respective harvest. Periods 4, 6, 8, and 9 were not sampled in District 2. Period 2 was used for period 4 age and stock estimates. Period 7 was used to estimate harvest composition from periods 6 to 9.

Two commercial periods with unrestricted mesh gillnets occurred in District 3 and these harvests were not sampled. Age and stock estimates from the subsistence harvest in the village of Holy Cross (rm 279, near the District 3 upper boundary) were used to estimate the District 3 commercial harvest. There was no Chinook salmon commercial harvest in District 4.

Age data was collected from all 3 commercial periods in District 5 (set gillnets and fish wheels) and 3 of 7 periods in District 6 (fish wheels). Age data from each period in District 5 were applied to each respective harvest. Genetic data from all 3 District 5 periods were combined to estimate the District 5 stock composition. Age data from District 6, periods 1 and 2, were applied to each respective harvest; period 3 was used to estimate periods 3 to 7. The stock composition of all harvests occurring in District 6, Tanana River, was assigned to the Middle stock group based on geographic location.

Subsistence

Sample goals from subsistence fisheries ranged from 250 to 400 fish from each location, depending on the difficulty in obtaining samples and the respective magnitude of local harvests. Subsistence harvests were sampled for age and stock in 4 districts and 8 locations: District 1, District 3 (Holy Cross), District 4 (Kaltag, Nulato, Bishop Rock, Galena, Ruby), and District 5 (Rampart Rapids) (Tables 1 and 3). Genetic data only were collected from subsistence harvests in the village of Tanana (District 5). Subsistence harvest estimates were available by village. Some of the harvest samples were used directly to estimate age and stock from a specific location. Most of the harvest samples were pooled and applied to groups of villages. Where subsistence harvest samples were lacking, other samples from nearby test fisheries, commercial harvests, or escapements were used.

District 1 subsistence harvests were sampled in the villages of Alakanuk (rm 17) and Emmonak (rm 24). The age composition from the District 1 subsistence harvest samples was weighted 3:1 with the Lower River Test Fishery (LYTF) to estimate age composition for the District 1 subsistence harvest. This method was chosen because the LYTF catch, which were given away for subsistence use, were approximately one-fourth of the District 1 subsistence harvest. The genetic data collected from the District 1 subsistence harvest were applied to that harvest; LYTF genetic data were not available.

The District 2 subsistence harvest was not sampled; age and stock estimates were derived from two test fisheries occurring in District 2, and from the first two commercial fishing periods in District 2 that allowed unrestricted mesh size gillnets. Age and genetic data from the Pilot Station Test Fishery (rm 122) were used to estimate age and stock composition for 600 fish in the subsistence harvest to account for those fish given away from the test fishery. The remainder of the District 2 subsistence harvest age composition was estimated by pooling the age composition from the Marshall Test Fishery (rm 161), District 2 period 1, and District 2 period 3.

The remainder of the District 2 subsistence harvest stock composition was from District 2 periods 1 and 3 stock estimates.

Age and genetic data from the subsistence harvest in the village of Holy Cross (rm 279), collected by Tanana Chiefs Conference (TCC), were used to estimate the age and stock composition of the District 3 subsistence harvest.

The District 4 age and stock composition subsistence harvest estimates were divided between mainstem and upper Koyukuk River harvests. Mainstem Yukon River subsistence harvests in District 4 occur along 375 river miles, from the District 3/4 boundary (rm 306) to the District 4/5 boundary (rm 681; Figure 1, Hayes et al. 2008). The City of Kaltag collected age and genetic data from Chinook salmon harvested in the subsistence fishery near Kaltag (rm 450). Yukon River Drainage Fisheries Association contracted with fishermen to collect age and genetic data from harvests near Nulato (rm 484), Galena (rm 530), and Ruby (rm 581). TCC collected age and genetic data from Bishop Rock fish camp (rm 514). Age and genetic data from samples collected near Holy Cross (rm 279) were applied to subsistence harvests from the villages of Anvik (rm 317) and Grayling (rm 336). Age and genetic data from samples collected near Kaltag, Nulato, and Bishop Rock fish camp were combined and applied to harvests from the villages of Kaltag, Nulato, and Koyukuk (rm 502). Age and genetic data from samples collected near Galena and Ruby were combined and applied to harvests from these villages.

Subsistence harvests in District 4 from upper Koyukuk River villages (Alatna, Allakaket, Bettles, Hughes, and Huslia) were assigned to the Middle stock group based upon genetic classification of the baseline samples collected from this area (South Fork Koyukuk River and Henshaw Creek; Templin et al. 2005; Smith et al. 2005). U. S. Fish and Wildlife Service (USFWS) crews sampled live salmon at weir projects on the Gisasa River and Henshaw Creek. Age composition from these escapement projects in the Koyukuk River drainage, were combined and applied to upper Koyukuk River subsistence harvest.

Mainstem Yukon River subsistence harvests in District 5 occur along 543 river miles, from the District 4/5 boundary (rm 681) to the U.S./Canada border (rm 1,224; Figure 1, Hayes et al. 2008). Age and stock estimates in District 5 were separated by location: harvests downstream of Fort Yukon (rm 1,002) excluding Tanana, harvests from Tanana (rm 695), harvests from Fort Yukon (rm 1,002) to the Canadian border (rm 1,224), and harvests from Chandalar and Black rivers. TCC collected genetic data from subsistence harvests near Tanana. Stan Zuray, Rapids Research Center, collected genetic data from the subsistence fishery near Rampart Rapids (rm 731). ADF&G collected age data from the Rampart Rapids subsistence harvest and from the Eagle Test Fishery (rm 1,213).

Ages from the District 5 commercial fishery were combined with those from the Rampart Rapids subsistence harvest to estimate the age composition from all harvests downstream of Fort Yukon and from the Chandalar and Black rivers. Ages from the Eagle Test Fishery, District 5 commercial fishery, and Rampart Rapids were combined to estimate harvest age composition of harvests from Fort Yukon to the Canadian border. Stock estimates from Rampart Rapids were applied to all District 5 subsistence harvests downstream of Fort Yukon, excluding Tanana. Stock estimates from samples collected in Tanana were applied to harvests from that village. Subsistence harvests from Fort Yukon to the Canadian border were assigned to the Upper stock group assuming these fish are bound for Canada. The Chandalar and Black rivers subsistence

harvest was assigned to the Middle stock group because these fish are bound for spawning grounds in Alaska.

Ages of the District 6 subsistence harvest were estimated by combining the ages from the District 6 commercial harvest and the Salcha River escapement samples. During peak spawning mortality Bering Sea Fisherman's Association (BSFA) sampled carcasses at the Salcha River. The stock composition of all harvests occurring in District 6, Tanana River, was assigned to the Middle stock group based on geographic location.

Sport

The age composition of the U.S. Yukon River drainage sport fish harvest was estimated from the Salcha River escapement samples. The majority of the sport fish harvest in the drainage comes from the Tanana River drainage, of which, the Salcha River is one of the major producers of Chinook salmon. All sport fish harvests were assigned to the Middle stock group based on geographic location.

CANADIAN HARVEST BY AGE

Ages of all harvests in Canada were derived from Chinook salmon caught in fish wheels. Samples were collected by Canada Department of Fisheries and Oceans (DFO) at White Rock and Sheep Rock in the Yukon Territory, just upstream of the U.S./Canada border. The age composition of the fish wheel catches was not used directly. Fish wheels preferentially harvest younger fish; therefore, the age composition of fish wheel catches does not represent the true age of the Canadian harvest. In 1996, a comparative analysis of historical Canadian age data from fish wheels, commercial gillnets, and spawning ground escapements was conducted (Jeff Bromaghin, ADF&G, Commercial Fisheries Biologist, Anchorage, personal communication). Selectivity coefficients developed from this analysis were applied to the fish wheel catch age composition, and the resulting age composition (termed "upriver adjusted") is a more accurate estimate for the Canadian harvest (Table 1). All harvests occurring in Canada were assigned to the Upper stock group based on geographic location.

DATA SOURCES

Data were compiled from multiple sources to apportion Yukon River harvest estimates by age class and stock group. Commercial harvest of Chinook salmon in Alaska, by district and period, were from JTC 2008. Subsistence harvest estimates in Alaska, by district and village, were from Denna Jallen, Commercial Fisheries Biologist, ADF&G, Fairbanks (personal communication). Sport fish harvest estimates in the Tanana River drainage were from Brase 2009 and for the remainder of the U.S. portion of the drainage from Burr 2009. Canadian harvests from aboriginal, domestic, and sport fisheries were from JTC 2008 and Patrick Milligan, DFO, Whitehorse, Yukon Territory (personal communication). Age composition from Alaska locations were from Horne-Brine et al. 2009. Age compositions from Canada were from Patrick Milligan (personal communication). Stock composition estimates were from DeCovich and Templin 2009 and from Nick DeCovich, Gene Conservation Laboratory, ADF&G, Anchorage (personal communication).

RESULTS

AGE AND GENETIC SAMPLES

Age data collected from commercial, subsistence, test fisheries, and escapement locations were used to estimate various portions of the harvest age composition (Table 1). Overall, age-1.4 Chinook salmon percentages were highest in the lower river commercial harvests that utilized unrestricted mesh size gillnets (range 69.9% to 85.4%; Table 1), and in subsistence harvests from the villages of Holy Cross, Kaltag, Nulato; and Bishop Rock fish camp. These locations typically use large-mesh gear to target Chinook salmon. Commercial harvests using gillnets restricted to mesh ≤6 inch had much lower percentages of age-1.4 fish (range 22.3% to 47.9%; Table 1). The restricted mesh commercial periods and harvests from fish wheels had higher percentages of age-1.2 and age-1.3 Chinook salmon.

Genetic samples from 3,746 Chinook salmon were collected from 17 commercial harvest periods and pooled into 14 groups to estimate the stock composition of Yukon River commercial harvests (Table 2). The majority of the samples were from 6 periods in Districts 1 and 2, commercial harvests with unrestricted mesh size. These harvests were generally earlier in the season and had higher estimates for the Upper stock group (range 0.420 to 0.692; Table 2) compared with the restricted mesh periods. Subsistence harvest samples were collected from 9 locations; total non-commercial harvest samples, including one test fishery was 2,987 fish (Table 3).

STOCK COMPOSITION BY HARVEST

Commercial

The District 1 commercial harvest of 19,465 Chinook salmon was composed of an estimated 5,413 Lower, 5,934 Middle, and 8,118 Upper stock fish (Table 4). The unrestricted mesh periods (1, 3, and 5) harvested the most fish overall and were predominated by the Upper stock group (Table 4 and Figure 3). The Lower stock group predominated in all but one of the restricted mesh periods. The Middle stock percentage varied little during periods 1, 3, 4, and 5; and decreased in the remaining periods (Figure 3).

The District 2 commercial fishery harvest of 13,306 Chinook salmon was composed of an estimated 3,694 Lower, 3,457 Middle, and 6,154 Upper stock fish (Table 5). Similar with District 1, the unrestricted mesh periods (1, 3, and 5), harvested the most fish and were predominated by the Upper stock group (Table 5 and Figure 4). The last District 2 period sampled had the highest Lower stock percentage. In the relatively small District 5 harvest, the Upper stock predominated and the Lower stock was absent (Table 6, Figure 5).

Subsistence

In the Districts 1–5 subsistence harvests, the Upper stock group predominated in all except District 4, where the Middle stock group was greater (Tables 6 and 7; Figure 5). The District 5 subsistence harvest was the largest harvest overall (19,165 fish) and the largest Upper stock group harvest (15,786 fish; Table 6 and Figure 5). District 4 was the second largest subsistence harvest by district (11,831 fish; Table 6) and had the largest percentage of Alaskan-origin fish, Lower and Middle stocks combined (56.5%, Table 7).

TOTAL HARVEST

In 2007, the Chinook salmon total harvest for U.S. and Canada was 94,649 fish (Table 6). The estimated Lower stock harvest was 12,311 fish (13.0%), Middle was 28,924 fish (30.6%), and Upper was 53,414 fish (56.4%; Tables 6 and 7). The Upper stock harvest by country was 48,320 fish by the U.S. and 5,094 fish by Canada (Table 8). Age-1.4 fish predominated (56,820), followed by age-1.3 (25,077), and age-1.2 fish (10,420; Tables 6 and 7).

DISCUSSION

Yukon River Chinook salmon harvests have decreased substantially in the last 10 years. From 1981 to 1997 the minimum harvest was 158,234; from 1998 to 2007 the harvest range was 50,187 to 136,783 (Table 8). Overall, the total 2007 harvest of U.S. and Canadian Yukon River Chinook salmon stocks was below the historical 5-year and 10-year averages.

Comparing the 2007 harvest by stock group to the 5-year and 10-year averages, the Lower stock was below average, the Middle stock was above average, and the Upper stock was near average (Table 9). After a record low percentage in 1999 (6.3%, Table 9), the Middle stock percentage has increased nearly five-fold in 2007. Conversely, the Lower stock percentage has decreased from a record high of 40.1% in 1999 to 13.0% in 2007 (Table 9).

Lower river stock composition temporal trends observed in previous years were present in 2007. In general, the Upper stock decreases during the season and the Lower stock increases (Decovich and Templin 2009). A temporal trend of decreasing Upper stock percentages was observed in the unrestricted mesh periods (1, 2, and 5) and restricted mesh periods (4, 6, 7, and 8; Figure 3). Conversely, the Lower stock increased temporally in the unrestricted mesh and restricted mesh periods (Figure 3). The explanation for this trend is that Upper stock fish must travel further to their Canadian spawning grounds, therefore run timing past the river mouth must be earlier. Eiler et al. (2004) showed stock composition of radiotagged Chinook salmon returning to lower basin tributaries was greater in the latter half of the run.

Horne-Brine et al. (2009) noted the age-1.4 percentage in the 2007 harvests was above average compared to historical data. Escapement into the Chena and Salcha rivers in 2001 (the parent year for age-1.4 fish) far exceeded the biological escapement goal established for each of these Tanana River tributaries (JTC 2008). Canadian mainstem spawning escapement estimates were also well above the interim escapement objective (JTC 2008). Good production from these escapements partly accounts for the relative abundance of age-1.4 fish of Middle and Upper stock origin in the 2007 Alaskan harvest.

Comparing historical trends in stock composition can be tenuous because data available to apportion harvests varies across years. Lower river commercial harvests had relatively consistent data collected across years; however, subsistence harvests were not well sampled before the late 1990s. For example, the 1997 District 4 subsistence harvest was not sampled and the District 2 commercial harvest was used for stock composition (Lingnau and Bromaghin 1999). ADF&G recognized the need to better assess the relatively large subsistence harvest in District 4, which had accounted for nearly one-fourth of the subsistence harvest in Alaska (2000–2004 average 10,982; Alaska Yukon River total 48,061; Busher et al. 2007). ADF&G Division of Commercial Fisheries staff encouraged various Non-Government Organizations to collect subsistence harvest data in mainstem districts and the village of Kaltag began collecting subsistence harvest age and stock data in 1999. From 1999 to 2004 the Kaltag data was used solely or combined with data

from 1 to 2 other harvests to estimate age and stock composition from the district e.g., Kaltag, Galena, and Ruby were combined in 2001 (Moore 2002). From 2005 to 2007 District 4 subsistence samples were collected from Kaltag, Nulato, Bishop Rock, Galena, and Ruby to apportion age and stock composition of the district. This increased sampling undoubtedly leads to more accurate stock composition estimates.

The recent sampling in District 4 has led to a better understanding of harvest stock composition by village. The Middle stock group predominated in 2007 in the District 4 subsistence harvests. The villages of Galena and Ruby, had the highest Middle stock estimates (Table 3), of which, the major component is Tanana River origin (Decovich and Templin 2009). The Tanana River flows into the south-side Yukon River 165 rm upstream of Galena and 114 rm upstream of Ruby. Many fishermen in these villages use fish wheels and set gillnets along the south bank. The high estimates of Middle stock fish from these villages is attributed to Tanana River origin fish being south-bank orientated near these villages. In 2005 and 2006, samples from the village of Ruby also had high percentages of Middle stock fish (DuBois and DeCovich 2008; Templin et al. 2008).

The method used to apportion District 5 stock composition changed in 2004. From 1981 through 2003, all District 5 harvests (rm 681 to 1,224) were assigned to the Upper stock group assuming most of these fish were bound for Canada (e.g., Lingnau and Bromaghin 1999). A new genetic baseline was developed in 2004 (Templin et al. 2006b) and District 5 harvests downstream of Fort Yukon (rm 681 to 1,002) were treated as mixed stocks and stock composition was estimated from samples collected in the area. Contributions from Alaskan tributaries flowing into the mainstem Yukon River in District 5, identified as 'Upper U.S. Yukon' by DeCovich and Templin (2009), were represented by collections from 3 tributaries (Beaver Creek, Chandalar and Sheenjek rivers) in the genetic baseline. In 2007, the Rampart Rapids subsistence harvest (rm 731, District 5) was estimated to be 0.252 of Middle stock origin (Table 3). Methods to apportion stock composition will be revised as the genetic baseline is improved.

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REFERENCES CITED

Barton, L. H. 1984. A catalog of Yukon River salmon spawning surveys. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Report 121, Juneau.

Beacham, T. D., C. B. Murray, and R. E. Withler. 1989. Age, morphology, and biochemical genetic variation of Yukon River Chinook salmon. Transactions of the American Fisheries Society 118:46–63.

Brase, A. L. J. 2009. Fishery management report for recreational fisheries in the Lower Tanana River management area, 2007. Alaska Department of Fish and Game, Fishery Management Report No. 09-23, Anchorage.

Burr, J. 2009. Fishery management report for sport fisheries in the Yukon management area, 2007. Alaska Department of Fish and Game, Fishery Management Report No. 09-43, Anchorage.

Busher, W. H., T. Hamazaki, and A. M. Marsh. 2007. Subsistence and personal use salmon harvests in the Alaskan portion of the Yukon River Drainage, 2005. Alaska Department of Fish and Game, Fishery Data Series No. 07-52, Anchorage.

Clutter, R. I., and L. E. Whitesel. 1956. Collection and interpretation of sockeye salmon scales. Bulletin of the International Pacific Salmon Fisheries Commission 9, Vancouver, British Columbia.

Debevec, E. M., R. B. Gates, M. Masuda, J. Pella, J. Reynolds, and L. W. Seeb. 2000. SPAM (Version 3.2): Statistics program for analyzing mixtures. Journal of Heredity 91:509-511.

DeCovich, N. A., and W. D. Templin. 2009. Genetic stock identification of Chinook salmon harvest on the Yukon River 2007. Alaska Department of Fish and Game, Fishery Data Series No. 09-39, Anchorage.

DuBois, L. 2005. Origins of Chinook salmon in the Yukon River fisheries, 2003. Alaska Department of Fish and Game, Fishery Data Series No. 05-46, Anchorage.

DuBois, L., J. M. Berger, N. A. DeCovich, and W. D. Templin. 2009. Origins of Chinook salmon in the Yukon River fisheries, 2004. Alaska Department of Fish and Game, Fishery Data Series No. 09-13, Anchorage.

DuBois, L., and N. A DeCovich. 2008. Origins of Chinook salmon in the Yukon River fisheries, 2005. Alaska Department of Fish and Game, Fishery Data Series No. 08-02, Anchorage.

Eiler, J. H., T. R. Spencer, J. J. Pella, M. M. Masuda, and R. R. Holder. 2004. Distribution and movement patterns of Chinook salmon returning to the Yukon River basin in 2000-2002. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-148, 99p.

Hayes, S. J., F. S. Bue, B. M. Borba, K. R. Boeck, H. C. Carroll, L. Boeck, E. J. Newland, K. J. Clark, and W. H. Busher. 2008. Annual management report Yukon and Northern areas, 2002-2004. Alaska Department of Fish and Game, Fishery Management Report No. 08-36, Anchorage.

Horne-Brine, M. H., J. Bales, and L. DuBois. 2009. Salmon age and sex composition and mean lengths for the Yukon River Area, 2007. Alaska Department of Fish and Game, Fishery Data Series No. 09-26, Anchorage.

INFPC (International North Pacific Fisheries Commission). 1963. Red salmon scale studies. International North Pacific Fisheries Commission, Annual Report 1961, Vancouver, Canada.

JTC (Joint Technical Committee of the Yukon River US/Canada Panel). 2008. Yukon River salmon 2007 season summary and 2008 season outlook. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A08-01, Anchorage.

Lingnau, T. L., and J. F. Bromaghin. 1999. Origins of Chinook salmon in the Yukon River fisheries, 1997. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A99-09, Anchorage.

McBride, D. N., and S. L. Marshall. 1983. Feasibility of scale pattern analysis to identify the origins of Chinook salmon (*Oncorhynchus tshawytscha* Walbaum) in the Lower Yukon River commercial gillnet fishery, 1980-1981. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 208, Juneau.

REFERENCES CITED (Continued)

Merritt, M. F., J. A. Wilcock, and L.K. Brannian. 1988. Origins of Chinook salmon in the Yukon River fisheries, 1986. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report No. 223, Anchorage.

Moore, H. 2002. Origins of Chinook salmon in the Yukon River fisheries, 2001. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A02-45, Anchorage.

Mosher, K. H. 1969. Identification of Pacific salmon and steelhead trout by scale characteristics. United States Department of the Interior, United States Fish and Wildlife Service, Bureau of Commercial Fisheries, Circular 317, Washington, D.C.

Schneiderhan, D. J. 1997. A history of scale pattern analysis as applied to stock identification of Chinook and chum salmon in the Yukon River. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 3A97-33, Anchorage.

Smith, C. T., W. D. Templin, J. E. Seeb, and L. W. Seeb. 2005. Single nucleotide polymorphisms (SNPs) provide rapid and accurate estimates of the percentages of U.S. and Canadian Chinook salmon caught in Yukon River fisheries. North American Journal of Fisheries Management 25:944-953.

Templin, W. D., N. A. DeCovich, and L. W. Seeb. 2008. Genetic stock identification of Chinook salmon harvest on the Yukon River, 2006. Alaska Department of Fish and Game, Fishery Data Series No. 08-15, Anchorage.

Templin, W. D., J. Berger, N. A. Decovich, and L. W. Seeb. 2006a. Genetic stock identification of Chinook salmon harvest on the Yukon River in 2004. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A06-06, Anchorage.

Templin, W. D., N. A. Decovich, and L. W. Seeb. 2006b. Genetic stock identification of Chinook salmon harvest on the Yukon River in 2005. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A06-05, Anchorage.

Templin, W. D., R. L. Wilmot, C. M. Guthrie III, and L. W. Seeb. 2005. United States and Canadian Chinook salmon populations in the Yukon River can be segregated based on genetic characteristics. Alaska Fishery Research Bulletin 11(1):44-60.

Wilmot, R. L., R. J. Everett, W. J. Spearman, and R. Baccus. 1992. Genetic stock identification of Yukon River chum and Chinook salmon, 1987 to 1990 progress report. U.S. Fish and Wildlife Service, Alaska Fish and Wildlife Research Center, Anchorage.

TABLES AND FIGURES

Table 1.–Yukon River Chinook salmon commercial, subsistence, test fishery, and escapement age composition by location and gear, 2007.

			Age Class (Percent)									
Fishery / Location / Period	Gear [a]	Sample Size	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5
Commercial												
District 1 Period 1	UGN	397	0.0	3.0	17.4	0.0	75.8	0.0	3.0	0.8	0.0	0.0
District 1 Period 3	UGN	396	0.0	0.8	12.4	0.0	85.4	0.0	1.5	0.0	0.0	0.0
District 1 Period 4	RGN	113	0.0	31.9	38.1	0.0	30.1	0.0	0.0	0.0	0.0	0.0
District 1 Period 5	UGN	390	0.0	3.6	10.8	0.0	83.8	0.0	1.8	0.0	0.0	0.0
District 1 Period 6	RGN	138	0.0	26.1	34.1	0.0	37.7	0.7	1.4	0.0	0.0	0.0
District 1 Period 7	RGN	188	0.0	27.1	25.0	0.0	47.9	0.0	0.0	0.0	0.0	0.0
District 1 Period 8	RGN	163	0.0	27.0	30.7	0.0	42.3	0.0	0.0	0.0	0.0	0.0
District 1 Periods 9, 10	RGN	192	0.0	20.2	34.5	0.0	43.7	0.0	1.6	0.0	0.0	0.0
District 2 Period 1	UGN	316	0.0	1.9	25.3	0.0	69.9	0.6	0.9	1.3	0.0	0.0
District 2 Period 2	RGN	158	0.0	38.6	33.5	0.0	27.2	0.6	0.0	0.0	0.0	0.0
District 2 Period 3	UGN	390	0.0	5.9	20.5	0.0	72.6	0.0	0.8	0.3	0.0	0.0
District 2 Period 5	UGN	399	0.0	3.5	20.6	0.0	73.4	0.3	2.3	0.0	0.0	0.0
District 2 Period 7	RGN	139	0.0	49.6	27.3	0.0	22.3	0.7	0.0	0.0	0.0	0.0
District 5	SGN/FW	439	0.0	15.6	37.4	0.3	45.9	0.0	0.8	0.0	0.0	0.0
District 6	FW	91	3.2	34.2	18.8	0.0	42.1	0.0	1.6	0.0	0.0	0.0
Subsistence												
District 1	GN	129	0.0	8.5	32.6	0.0	58.9	0.0	0.0	0.0	0.0	0.0
District 3 Holy Cross	GN	204	0.0	2.5	23.5	0.0	72.5	0.0	1.0	0.5	0.0	0.0
District 4 Kaltag, Nulato, Bishop Rock	GN	503	0.0	4.4	20.9	0.0	74.4	0.0	0.4	0.0	0.0	0.0
District 4 Galena, Ruby	SGN/FW	329	0.0	32.8	34.7	0.3	31.9	0.0	0.3	0.0	0.0	0.0
District 5 Rampart Rapids	FW	85	0.0	23.5	50.6	1.2	23.5	0.0	1.2	0.0	0.0	0.0
Test Fishery												
District 1 LYTF [b]	SGN	1,030	0.0	4.7	14.4	0.0	80.1	0.1	0.8	0.0	0.0	0.0
District 2 Pilot Station	DGN	482	0.0	13.1	34.9	0.0	50.8	0.2	0.8	0.2	0.0	0.0
District 2 Marshall	DGN	210	0.0	3.8	17.1	0.0	78.6	0.0	0.5	0.0	0.0	0.0
District 5 Eagle	DGN	389	0.0	5.7	40.1	0.0	53.5	0.3	0.5	0.0	0.0	0.0
Canada	FW	711	0.4	21.5	42.8	0.1	31.5	1.4	1.0	1.3	0.0	0.0
Canada (upriver adjusted) [c]			0.1	1.0	27.5	0.1	61.6	2.8	3.0	3.9	0.0	0.0
Escapement												
Gisasa River and Henshaw Creek weirs	Trap	614	0.0	38.5	20.5	0.0	40.8	0.1	0.1	0.0	0.0	0.0
Salcha River	Carcass	308	0.0	22.4	26.9	0.0	50.3	0.0	0.3	0.0	0.0	0.0

[a] UGN is unrestricted mesh size gillnet, RGN is restricted ≤6-inch mesh size gillnet, SGN is set gillnet, DGN is drift gillnet, GN is gillnet, FW is fish wheel, and trap is a live-sampling enclosure built into a weir.

[b] LYTF is Lower Yukon River Test Fishery which includes Big Eddy and Middle Mouth sites.

[c] Adjusted age composition after gear-selectivity coefficients were applied to the combined Sheep Rock and White Rock fish wheel age composition to obtain a more accurate estimate of the border passage escapement age composition.

Table 2.–Genetic stock group estimates from Yukon River Chinook salmon commercial harvest samples, 2007.

District	Period/ Date	Stock Group	Sample Size	Est.	90% CI
1	Period 1	Lower	393	0.126	(0.089-0.162)
	June 19-20	Middle		0.325	(0.265-0.380)
	unrestricted	Upper		0.549	(0.493-0.610)
1	Period 3	Lower	399	0.150	(0.112-0.193)
	June 21-22	Middle		0.399	(0.336-0.456)
	unrestricted	Upper		0.451	(0.400-0.511)
1	Period 4	Lower	100	0.315	(0.224-0.403)
	June 22	Middle		0.309	(0.198-0.401)
	restricted	Upper		0.377	(0.289-0.489)
1	Period 5	Lower	399	0.234	(0.191-0.280)
	June 25-26	Middle		0.346	(0.283-0.398)
	unrestricted	Upper		0.420	(0.372-0.480)
1	Period 6	Lower	139	0.464	(0.371-0.557)
	June 27	Middle		0.196	(0.122-0.306)
	restricted	Upper		0.340	(0.243-0.420)
1	Period 7	Lower	198	0.671	(0.607-0.741)
	June 30	Middle		0.140	(0.078-0.207)
	restricted	Upper		0.189	(0.133-0.249)
1	Period 8	Lower	168	0.787	(0.713-0.845)
	July 2	Middle		0.077	(0.034-0.146)
	restricted	Upper		0.136	(0.081-0.187)
1	Periods 9,10	Lower	199	0.634	(0.562-0.696)
	July 6, 9-10	Middle		0.125	(0.073-0.191)
	restricted	Upper		0.241	(0.177-0.306)
2	Period 1	Lower	321	0.027	(0.002-0.058)
	June 15	Middle		0.281	(0.225-0.364)
	unrestricted	Upper		0.692	(0.617-0.746)
2	Period 2	Lower	155	0.192	(0.128-0.258)
	June 19	Middle		0.361	(0.268-0.444)
	restricted	Upper		0.447	(0.364-0.539)
2	Period 3	Lower	398	0.284	(0.236-0.332)
	June 20	Middle		0.253	(0.195-0.315)
	unrestricted	Upper		0.463	(0.401-0.518)
2	Period 5	Lower	394	0.150	(0.102-0.190)
	June 20	Middle		0.318	(0.266-0.378)
	unrestricted	Upper		0.533	(0.478-0.587)
2	Period 7	Lower	88	0.618	(0.497-0.721)
	June 28	Middle		0.153	(0.060-0.248)
	restricted	Upper		0.229	(0.150-0.336)
5	Periods 1-3	Lower	395	0.000	(0.000-0.007)
	July 4, 6, 11	Middle		0.349	(0.283-0.400)
		Upper		0.651	(0.599-0.717)
	Total commercial		3,746		

Table 3.–Genetic stock group estimates from Yukon River non-commercial harvest samples, 2007.

District	Location/ Fishery	Stock Group	Sample Size	Est.	90% CI
1	Emmonak	Lower	235	0.068	(0.037-0.120)
	Subsistence	Middle		0.366	(0.287-0.454)
		Upper		0.566	(0.473-0.637)
2	Pilot Station	Lower	549	0.366	(0.329-0.412)
	Test Fishery	Middle		0.261	(0.198-0.298)
		Upper		0.373	(0.335-0.426)
3	Holy Cross	Lower	204	0.036	(0.003-0.066)
	Subsistence	Middle		0.352	(0.270-0.445)
		Upper		0.612	(0.526-0.697)
4	Kaltag, Nulato,	Lower	546	0.065	NA
	Bishop Mountain	Middle		0.410	
	Subsistence	Upper		0.526	
4	Galena, Ruby	Lower	357	0.091	NA
	Subsistence	Middle		0.717	
		Upper		0.192	
5	Tanana	Lower	317	0.000	(0.000-0.020)
	Subsistence	Middle		0.311	(0.235-0.376)
		Upper		0.689	(0.620-0.761)
5	Rampart Rapids	Lower	779	0.018	(0.006-0.034)
	Subsistence	Middle		0.252	(0.206-0.293)
		Upper		0.731	(0.689-0.774)
	Total non-commercial		2,987		

Table 4.–Yukon River Chinook salmon District 1 commercial harvest by age class, stock group, and period, 2007.

Period/	Stock	Age Class										
Date	Group	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Total
Period 1	Lower	0	16	94	0	409	0	16	4	0	0	540
June 18-19	Middle	0	42	243	0	1,058	0	42	10	0	0	1,396
Unrestricted	Alaska	0	59	337	0	1,467	0	59	14	0	0	1,936
	Upper	0	71	409	0	1,786	0	71	18	0	0	2,355
	Total	0	130	746	0	3,253	0	130	32	0	0	4,291
Period 2	Lower	0	26	31	0	25	0	0	0	0	0	82
June 20	Middle	0	26	31	0	24	0	0	0	0	0	81
Restricted	Alaska	0	52	62	0	49	0	0	0	0	0	163
	Upper	0	31	38	0	30	0	0	0	0	0	98
	Total	0	83	100	0	78	0	0	0	0	0	261
Period 3	Lower	0	7	109	0	751	0	13	0	0	0	880
June 21-22	Middle	0	18	291	0	2,006	0	36	0	0	0	2,350
Unrestricted	Alaska	0	25	400	0	2,758	0	49	0	0	0	3,231
	Upper	0	20	328	0	2,265	0	40	0	0	0	2,654
	Total	0	45	728	0	5,023	0	89	0	0	0	5,885
Period 4	Lower	0	63	76	0	60	0	0	0	0	0	199
June 22	Middle	0	62	74	0	59	0	0	0	0	0	195
Restricted	Alaska	0	125	150	0	118	0	0	0	0	0	394
	Upper	0	76	91	0	72	0	0	0	0	0	238
	Total	0	201	241	0	190	0	0	0	0	0	632
Period 5	Lower	0	28	85	0	662	0	14	0	0	0	790
June 25-26	Middle	0	42	126	0	982	0	21	0	0	0	1,171
Unrestricted	Alaska	0	70	211	0	1,644	0	35	0	0	0	1,961
	Upper	0	51	153	0	1,192	0	26	0	0	0	1,421
	Total	0	121	364	0	2,836	0	61	0	0	0	3,382
Period 6	Lower	0	129	168	0	186	4	7	0	0	0	494
June 27	Middle	0	55	71	0	79	2	3	0	0	0	209
Restricted	Alaska	0	184	239	0	265	5	10	0	0	0	702
	Upper	0	94	123	0	136	3	5	0	0	0	362
	Total	0	278	362	0	401	8	15	0	0	0	1,064
Period 7	Lower	0	227	209	0	401	0	0	0	0	0	837
June 30	Middle	0	47	44	0	83	0	0	0	0	0	174
Restricted	Alaska	0	274	253	0	484	0	0	0	0	0	1,011
	Upper	0	64	59	0	113	0	0	0	0	0	236
	Total	0	338	312	0	597	0	0	0	0	0	1,247
Period 8	Lower	0	175	197	0	274	0	0	0	0	0	646
July 2	Middle	0	17	19	0	27	0	0	0	0	0	63
Restricted	Alaska	0	192	217	0	301	0	0	0	0	0	709
	Upper	0	30	34	0	47	0	0	0	0	0	112
	Total	0	222	251	0	348	0	0	0	0	0	821
Periods 9-12 [a]	Lower	0	132	226	0	286	0	11	0	0	0	655
July 6, 9-10	Middle	0	26	45	0	57	0	2	0	0	0	129
12-13, 14-15	Alaska	0	158	270	0	343	0	13	0	0	0	784
Restricted	Upper	0	50	86	0	109	0	4	0	0	0	249
	Total	0	209	356	0	451	0	17	0	0	0	1,033
All Periods	Lower	0	843	1,239	0	3,054	4	62	188	0	0	5,413
Combined [b]	Middle	0	347	975	0	4,374	2	104	216	0	0	5,934
	Alaska	0	1,190	2,214	0	7,429	5	166	404	0	0	11,347
	Upper	0	495	1,369	0	5,750	3	146	294	0	0	8,118
	Total	0	1,685	3,583	0	13,179	8	312	698	0	0	19,465

[a] Periods 9–12 include 1 fish sold during fall season.

[b] Includes 849 fish from test fish sales.

Table 5.–Yukon River Chinook salmon District 2 commercial harvest by age class, stock group, and period, 2007.

Period/		Age Class										
Date	Stock Group	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Total
Period 1	Lower	0	1	14	0	39	0	1	1	0	0	56
June 15	Middle	0	11	148	0	409	4	6	7	0	0	585
Unrestricted	Alaska	0	12	162	0	448	4	6	8	0	0	641
	Upper	0	28	365	0	1,007	9	14	18	0	0	1,440
	Total	0	40	527	0	1,455	13	20	26	0	0	2,081
Period 2	Lower	0	52	45	0	37	1	0	0	0	0	135
June 19	Middle	0	98	85	0	69	1	0	0	0	0	253
Restricted	Alaska	0	150	130	0	106	2	0	0	0	0	388
	Upper	0	122	105	0	85	2	0	0	0	0	314
	Total	0	272	235	0	191	4	0	0	0	0	702
Period 3	Lower	0	66	229	0	811	0	9	3	0	0	1,117
June 20	Middle	0	59	204	0	722	0	8	3	0	0	995
Unrestricted	Alaska	0	125	433	0	1,532	0	16	6	0	0	2,112
	Upper	0	107	373	0	1,320	0	14	5	0	0	1,820
	Total	0	232	806	0	2,853	0	30	10	0	0	3,932
Period 4	Lower	0	31	27	0	22	0	0	0	0	0	80
June 21	Middle	0	58	50	0	41	1	0	0	0	0	150
Restricted	Alaska	0	89	77	0	62	1	0	0	0	0	229
	Upper	0	72	62	0	50	1	0	0	0	0	186
	Total	0	161	139	0	113	2	0	0	0	0	415
Period 5	Lower	0	17	99	0	354	1	11	0	0	0	483
June 24	Middle	0	36	211	0	752	3	23	0	0	0	1,025
Unrestricted	Alaska	0	53	310	0	1,107	4	34	0	0	0	1,507
	Upper	0	60	353	0	1,261	4	39	0	0	0	1,718
	Total	0	113	663	0	2,368	8	73	0	0	0	3,225
Periods 6-9 [a]	Lower	0	904	498	0	408	14	0	0	0	0	1,823
June 26, 28;	Middle	0	223	123	0	101	3	0	0	0	0	451
July 3, 8	Alaska	0	1,127	621	0	508	17	0	0	0	0	2,274
Restricted	Upper	0	336	185	0	151	5	0	0	0	0	677
	Total	0	1,463	806	0	660	22	0	0	0	0	2,951
All Periods	Lower	0	1,071	913	0	1,670	16	20	4	0	0	3,694
Combined	Middle	0	485	821	0	2,093	12	37	10	0	0	3,457
	Alaska	0	1,556	1,733	0	3,764	28	57	14	0	0	7,152
	Upper	0	724	1,443	0	3,876	21	67	23	0	0	6,154
	Total	0	2,281	3,177	0	7,639	49	123	36	0	0	13,306

[a] Periods 6–9 include 4 fish sold during fall season.

Table 6.–Yukon River Chinook salmon harvest by age class, stock group, district, and fishery, 2007.

District	Fishery	Stock Group	Age Class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Total
1	Commercial	Lower	0	843	1,239	0	3,054	4	62	188	0	0	5,413
		Middle	0	347	975	0	4,374	2	104	216	0	0	5,934
		Alaska	0	1,190	2,214	0	7,429	5	166	404	0	0	11,347
		Upper	0	495	1,369	0	5,750	3	146	294	0	0	8,118
		Total	0	1,685	3,583	0	13,179	8	312	698	0	0	19,465
	Subsistence	Lower	0	31	116	0	266	0	1	0	0	0	414
		Middle	0	168	621	0	1,424	1	4	0	0	0	2,218
		Alaska	0	199	737	0	1,690	1	5	0	0	0	2,631
		Upper	0	259	960	0	2,201	1	7	0	0	0	3,428
		Total	0	458	1,697	0	3,891	1	12	0	0	0	6,059
2	Commercial	Lower	0	1,071	913	0	1,670	16	20	4	0	0	3,694
		Middle	0	485	821	0	2,093	12	37	10	0	0	3,457
		Alaska	0	1,556	1,733	0	3,764	28	57	14	0	0	7,152
		Upper	0	724	1,443	0	3,876	21	67	23	0	0	6,154
		Total	0	2,281	3,177	0	7,639	49	123	36	0	0	13,306
	Subsistence	Lower	0	89	401	0	1,252	4	13	8	0	0	1,767
		Middle	0	124	612	0	2,038	6	21	14	0	0	2,815
		Alaska	0	212	1,014	0	3,290	10	34	22	0	0	4,582
		Upper	0	252	1,284	0	4,348	12	44	30	0	0	5,971
		Total	0	465	2,298	0	7,638	22	78	52	0	0	10,553
3	Commercial	Lower	0	0	2	0	5	0	0	0	0	0	7
		Middle	0	2	16	0	49	0	1	0	0	0	67
		Alaska	0	2	17	0	53	0	1	0	0	0	74
		Upper	0	3	27	0	84	0	1	1	0	0	116
		Total	0	5	45	0	138	0	2	1	0	0	190
	Subsistence	Lower	0	4	39	0	120	0	2	1	0	0	166
		Middle	0	40	385	0	1,188	0	16	8	0	0	1,638
		Alaska	0	44	424	0	1,309	0	18	9	0	0	1,804
		Upper	0	70	670	0	2,066	0	28	14	0	0	2,847
		Total	0	114	1,094	0	3,374	0	46	23	0	0	4,651
4	Subsistence	Lower	0	125	208	1	427	0	3	0	0	0	765
		Middle	0	1,046	1,616	8	3,213	0	26	5	0	0	5,914
		Alaska	0	1,171	1,824	9	3,640	0	30	5	0	0	6,679
		Upper	0	389	1,216	2	3,506	0	30	8	0	0	5,152
		Total	0	1,560	3,041	11	7,146	0	60	14	0	0	11,831
5	Commercial	Lower	0	0	0	0	0	0	0	0	0	0	0
		Middle	0	67	162	1	198	0	3	0	0	0	433
		Alaska	0	67	162	1	198	0	3	0	0	0	433
		Upper	0	126	303	3	371	0	7	0	0	0	808
		Total	0	193	465	4	569	0	10	0	0	0	1,241
	Subsistence	Lower	0	18	42	0	47	0	1	0	0	0	109
		Middle	0	537	1,273	12	1,417	0	31	0	0	0	3,270
		Alaska	0	555	1,315	13	1,464	0	32	0	0	0	3,379
		Upper	0	2,249	6,183	48	7,162	8	137	0	0	0	15,786
		Total	0	2,803	7,498	61	8,626	8	169	0	0	0	19,165

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Table 6.–Page 2 of 2.

District	Fishery	Stock Group	Age Class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Total
6	Commercial	Middle	6	108	52	0	111	0	3	0	0	0	281
	Subsistence	Middle	9	483	464	0	887	0	9	0	0	0	1,853
	Sport Fish	Middle	0	215	259	0	483	0	3	0	0	0	960
		Total	15	806	776	0	1,481	0	15	0	0	0	3,094
Canada	Test	Upper	0	6	170	1	380	17	19	24	0	0	617
	Aboriginal	Upper	3	45	1,232	4	2,758	123	135	174	0	0	4,475
	Sport Fish	Upper	0	0	1	0	1	0	0	0	0	0	2
		Total	3	51	1,403	5	3,139	140	154	198	0	0	5,094
Total Harvest		Lower	0	2,181	2,959	1	6,842	24	102	201	0	0	12,311
		Middle	15	3,621	7,258	22	17,475	20	259	253	0	0	28,924
		Alaska	15	5,803	10,217	23	24,317	44	361	454	0	0	41,235
		Upper	3	4,618	14,860	57	32,503	185	620	567	0	0	53,414
		Total	19	10,420	25,077	81	56,820	229	981	1,022	0	0	94,649

Table 7.–Yukon River Chinook salmon harvest percentage by age class, stock group, district, and fishery, 2007.

District	Fishery	Stock Group	Age Class (Percent)										Total
			1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	
1	Commercial	Lower	0.0	4.3	6.4	0.0	15.7	0.0	0.3	1.0	0.0	0.0	27.7
		Middle	0.0	1.8	5.0	0.0	22.5	0.0	0.5	1.1	0.0	0.0	30.9
		Alaska	0.0	6.1	11.4	0.0	38.2	0.0	0.9	2.1	0.0	0.0	58.6
		Upper	0.0	2.5	7.0	0.0	29.5	0.0	0.8	1.5	0.0	0.0	41.4
		Total	0.0	8.7	18.4	0.0	67.7	0.0	1.6	3.6	0.0	0.0	100.0
	Subsistence	Lower	0.0	0.5	1.9	0.0	4.4	0.0	0.0	0.0	0.0	0.0	6.8
		Middle	0.0	2.8	10.3	0.0	23.5	0.0	0.1	0.0	0.0	0.0	36.6
		Alaska	0.0	3.3	12.2	0.0	27.9	0.0	0.1	0.0	0.0	0.0	43.4
		Upper	0.0	4.3	15.8	0.0	36.3	0.0	0.1	0.0	0.0	0.0	56.6
		Total	0.0	7.6	28.0	0.0	64.2	0.0	0.2	0.0	0.0	0.0	100.0
2	Commercial	Lower	0.0	8.0	6.9	0.0	12.6	0.1	0.2	0.0	0.0	0.0	27.8
		Middle	0.0	3.6	6.2	0.0	15.7	0.1	0.3	0.1	0.0	0.0	26.0
		Alaska	0.0	11.7	13.0	0.0	28.3	0.2	0.4	0.1	0.0	0.0	53.8
		Upper	0.0	5.4	10.8	0.0	29.1	0.2	0.5	0.2	0.0	0.0	46.3
		Total	0.0	17.1	23.9	0.0	57.4	0.4	0.9	0.3	0.0	0.0	100.0
	Subsistence	Lower	0.0	0.8	3.8	0.0	11.9	0.0	0.1	0.1	0.0	0.0	16.7
		Middle	0.0	1.2	5.8	0.0	19.3	0.1	0.2	0.1	0.0	0.0	26.7
		Alaska	0.0	2.0	9.6	0.0	31.2	0.1	0.3	0.2	0.0	0.0	43.4
		Upper	0.0	2.4	12.2	0.0	41.2	0.1	0.4	0.3	0.0	0.0	56.6
		Total	0.0	4.4	21.8	0.0	72.4	0.2	0.7	0.5	0.0	0.0	100.0
3	Commercial	Lower	0.0	0.1	0.8	0.0	2.6	0.0	0.0	0.0	0.0	0.0	3.6
		Middle	0.0	0.9	8.3	0.0	25.6	0.0	0.3	0.2	0.0	0.0	35.2
		Alaska	0.0	1.0	9.1	0.0	28.1	0.0	0.4	0.2	0.0	0.0	38.8
		Upper	0.0	1.5	14.4	0.0	44.4	0.0	0.6	0.3	0.0	0.0	61.2
		Total	0.0	2.5	23.5	0.0	72.5	0.0	1.0	0.5	0.0	0.0	100.0
	Subsistence	Lower	0.0	0.1	0.8	0.0	2.6	0.0	0.0	0.0	0.0	0.0	3.6
		Middle	0.0	0.9	8.3	0.0	25.6	0.0	0.3	0.2	0.0	0.0	35.2
		Alaska	0.0	1.0	9.1	0.0	28.1	0.0	0.4	0.2	0.0	0.0	38.8
		Upper	0.0	1.5	14.4	0.0	44.4	0.0	0.6	0.3	0.0	0.0	61.2
		Total	0.0	2.5	23.5	0.0	72.5	0.0	1.0	0.5	0.0	0.0	100.0
4	Subsistence	Lower	0.0	1.1	1.8	0.0	3.6	0.0	0.0	0.0	0.0	0.0	6.5
		Middle	0.0	8.8	13.7	0.1	27.2	0.0	0.2	0.0	0.0	0.0	50.0
		Alaska	0.0	9.9	15.4	0.1	30.8	0.0	0.3	0.0	0.0	0.0	56.5
		Upper	0.0	3.3	10.3	0.0	29.6	0.0	0.3	0.1	0.0	0.0	43.5
		Total	0.0	13.2	25.7	0.1	60.4	0.0	0.5	0.1	0.0	0.0	100.0
5	Commercial	Lower	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Middle	0.0	5.4	13.1	0.1	16.0	0.0	0.3	0.0	0.0	0.0	34.9
		Alaska	0.0	5.4	13.1	0.1	16.0	0.0	0.3	0.0	0.0	0.0	34.9
		Upper	0.0	10.1	24.4	0.2	29.9	0.0	0.5	0.0	0.0	0.0	65.1
		Total	0.0	15.6	37.5	0.3	45.9	0.0	0.8	0.0	0.0	0.0	100.0
	Subsistence	Lower	0.0	0.1	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.6
		Middle	0.0	2.8	6.6	0.1	7.4	0.0	0.2	0.0	0.0	0.0	17.1
		Alaska	0.0	2.9	6.9	0.1	7.6	0.0	0.2	0.0	0.0	0.0	17.6
		Upper	0.0	11.7	32.3	0.3	37.4	0.0	0.7	0.0	0.0	0.0	82.4
		Total	0.0	14.6	39.1	0.3	45.0	0.0	0.9	0.0	0.0	0.0	100.0

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Table 7.–Page 2 of 2.

			Age Class (Percent)										
District	Fishery	Stock Group	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Total
6	Commercial	Middle	0.2	3.5	1.7	0.0	3.6	0.0	0.1	0.0	0.0	0.0	9.1
	Subsistence	Middle	0.3	15.6	15.0	0.0	28.7	0.0	0.3	0.0	0.0	0.0	59.9
	Sport Fish	Middle	0.0	7.0	8.4	0.0	15.6	0.0	0.1	0.0	0.0	0.0	31.0
		Total	0.5	26.1	25.1	0.0	47.9	0.0	0.5	0.0	0.0	0.0	100.0
Canada	Test	Upper	0.0	0.1	3.3	0.0	7.5	0.3	0.4	0.5	0.0	0.0	12.1
	Aboriginal	Upper	0.1	0.9	24.2	0.1	54.1	2.4	2.7	3.4	0.0	0.0	87.8
	Sport Fish	Upper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Total	0.1	1.0	27.5	0.1	61.6	2.8	3.0	3.9	0.0	0.0	100.0
Total Harvest		Lower	0.0	2.3	3.1	0.0	7.2	0.0	0.1	0.2	0.0	0.0	13.0
		Middle	0.0	3.8	7.7	0.0	18.5	0.0	0.3	0.3	0.0	0.0	30.6
		Alaska	0.0	6.1	10.8	0.0	25.7	0.0	0.4	0.5	0.0	0.0	43.6
		Upper	0.0	4.9	15.7	0.1	34.3	0.2	0.7	0.6	0.0	0.0	56.4
		Total	0.0	11.0	26.5	0.1	60.0	0.2	1.0	1.1	0.0	0.0	100.0

Table 8.–Yukon River Chinook salmon historical harvest by stock group for the United States and Canada, 1981–2007.

Year	Lower	Middle	Upper			Total
			U.S.	Canada	Total	
1981	11,164	112,669	64,644	18,109	82,753	206,586
1982	23,601	41,967	87,241	17,208	104,449	170,017
1983	28,081	73,361	96,994	18,952	115,946	217,388
1984	45,210	71,656	44,735	16,795	61,530	178,396
1985	57,770	46,753	85,773	19,301	105,074	209,597
1986	32,517	15,894	97,593	20,364	117,957	166,368
1987	32,847	40,281	115,258	17,614	132,872	206,000
1988	36,967	26,805	84,649	21,427	106,076	169,848
1989	42,872	27,936	86,798	17,944	104,742	175,550
1990	34,007	42,430	72,996	19,227	92,223	168,660
1991	49,113	44,328	61,210	20,607	81,817	175,258
1992	30,330	40,600	97,261	17,903	115,164	186,094
1993	38,592	45,671	78,815	16,611	95,426	179,689
1994	35,161	41,488	95,666	21,218	116,884	193,533
1995	35,518	44,404	97,741	20,887	118,628	198,550
1996	33,278	16,386	88,958	19,612	108,570	158,234
1997	50,420	32,043	92,162	16,528	108,690	191,153
1998	34,759	18,509	46,947	5,937	52,884	106,152
1999	54,788	8,619	60,908	12,468	73,376	136,783
2000	16,989	6,176	22,143	4,879	27,022	50,187
2001	20,115	10,190	23,325	10,139	33,421	63,726
2002	14,895	22,395	30,058	9,257	39,387	76,677
2003	7,394	31,232	59,940	9,619	69,559	108,185
2004	18,965	35,553	57,831	11,238	69,069	123,587
2005	19,893	20,607	44,650	11,074	55,724	96,223
2006	18,301	28,756	48,097	9,072	57,169	104,225
2007	12,311	28,924	48,320	5,094	53,414	94,649
Average (1981-2006)	31,675	36,412	70,861	15,538	86,400	154,487
10-Year Average (1997-2006)	25,652	21,408	48,606	10,021	58,630	105,690
5-Year Average (2002-2006)	15,890	27,709	48,115	10,052	58,181	101,780

Table 9.–Yukon River Chinook salmon historical harvest percentage by stock group for the United States and Canada, 1981–2007.

Year	Lower	Middle	Upper		
			U.S.	Canada	Total
1981	5.4	54.5	31.3	8.8	40.1
1982	13.9	24.7	51.3	10.1	61.4
1983	12.9	33.7	44.6	8.7	53.3
1984	25.3	40.2	25.1	9.4	34.5
1985	27.6	22.3	40.9	9.2	50.1
1986	19.5	9.6	58.7	12.2	70.9
1987	15.9	19.6	56.0	8.6	64.5
1988	21.8	15.8	49.8	12.6	62.5
1989	24.4	15.9	49.4	10.2	59.7
1990	20.2	25.2	43.3	11.4	54.7
1991	28.0	25.3	34.9	11.8	46.7
1992	16.3	21.8	52.3	9.6	61.9
1993	21.5	25.4	43.9	9.2	53.1
1994	18.2	21.4	49.4	11.0	60.4
1995	17.9	22.4	49.2	10.5	59.7
1996	21.0	10.4	56.2	12.4	68.6
1997	26.4	16.8	48.2	8.6	56.9
1998	32.7	17.4	44.2	5.6	49.8
1999	40.1	6.3	44.5	9.1	53.6
2000	33.9	12.3	44.1	9.7	53.8
2001	31.6	16.0	36.5	15.9	52.4
2002	19.4	29.2	39.3	12.1	51.4
2003	6.8	28.9	55.4	8.9	64.3
2004	15.3	28.8	46.8	9.1	55.9
2005	20.7	21.4	46.4	11.5	57.9
2006	17.6	27.6	46.1	8.7	54.9
2007	13.0	30.6	51.1	5.4	56.4
Average (1981-2006)	20.5	23.6	45.9	10.1	55.9
10-Year Average (1997-2006)	24.3	20.3	46.0	9.5	55.5
5-Year Average (2002-2006)	15.6	27.2	47.3	9.9	57.2

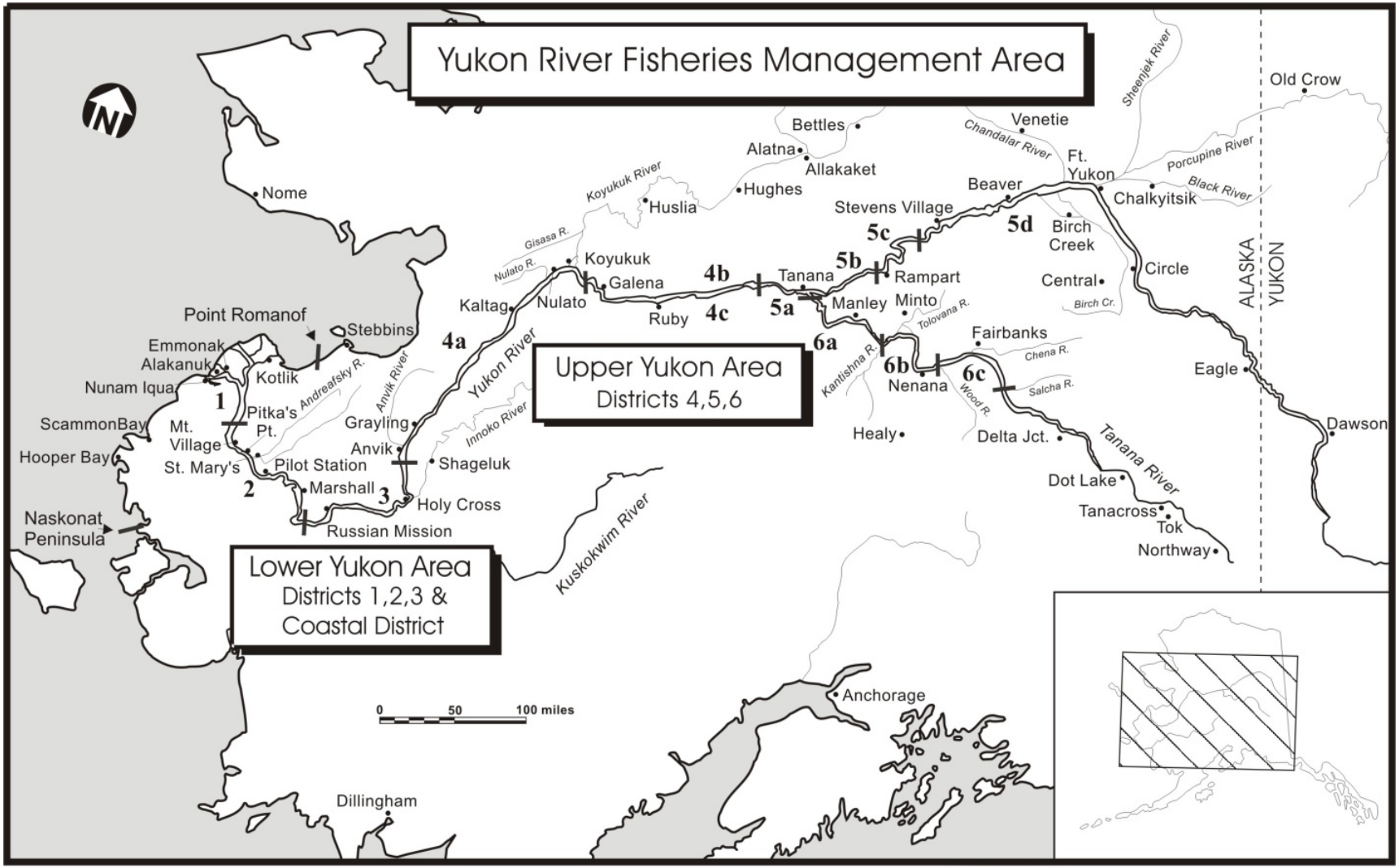


Figure 1.–Alaska portion of the Yukon River drainage with district boundaries and major spawning tributaries.

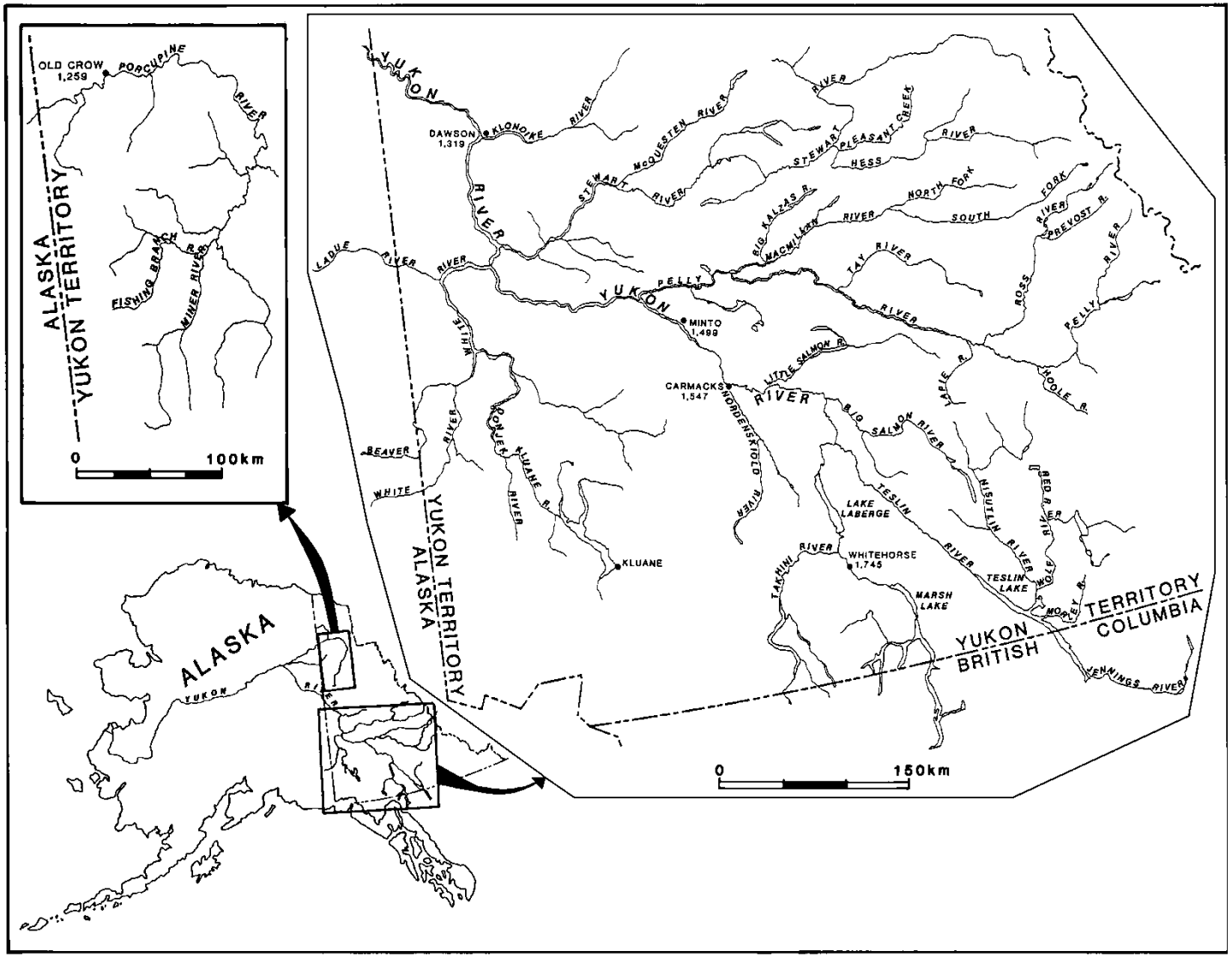


Figure 2.–Canada portion of the Yukon River drainage and major spawning tributaries.

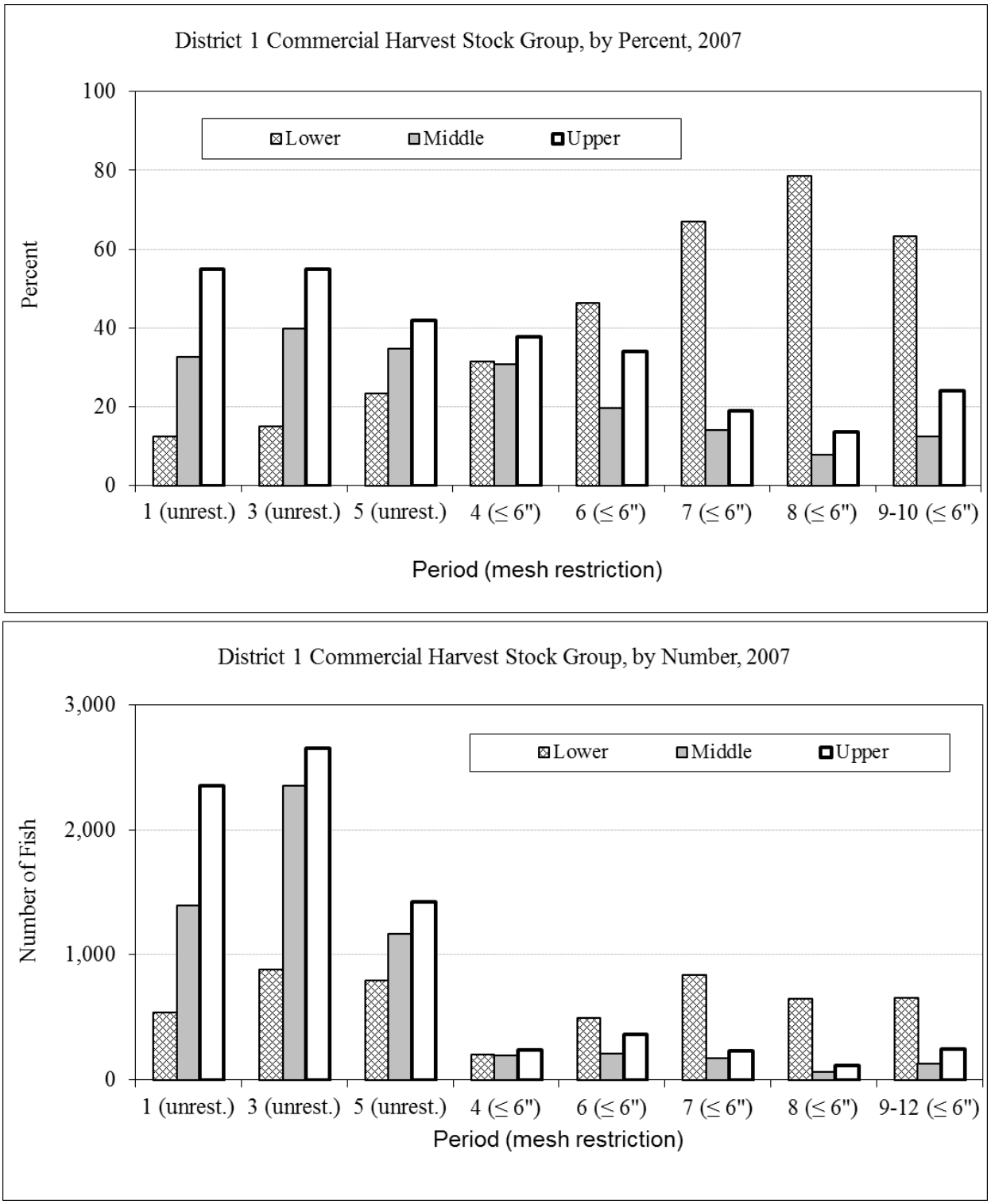
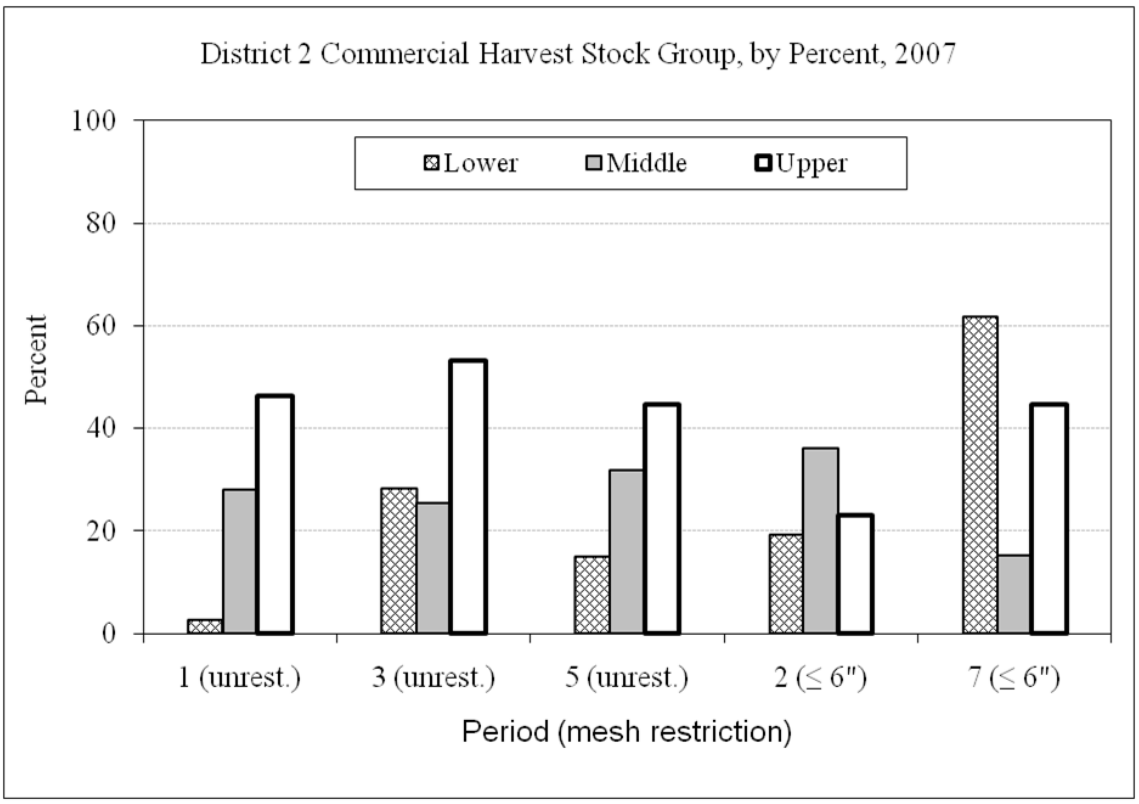


Figure 3.–Genetic stock composition from Yukon River District 1 commercial harvest periods, by percentage (upper) and number (lower), 2007.



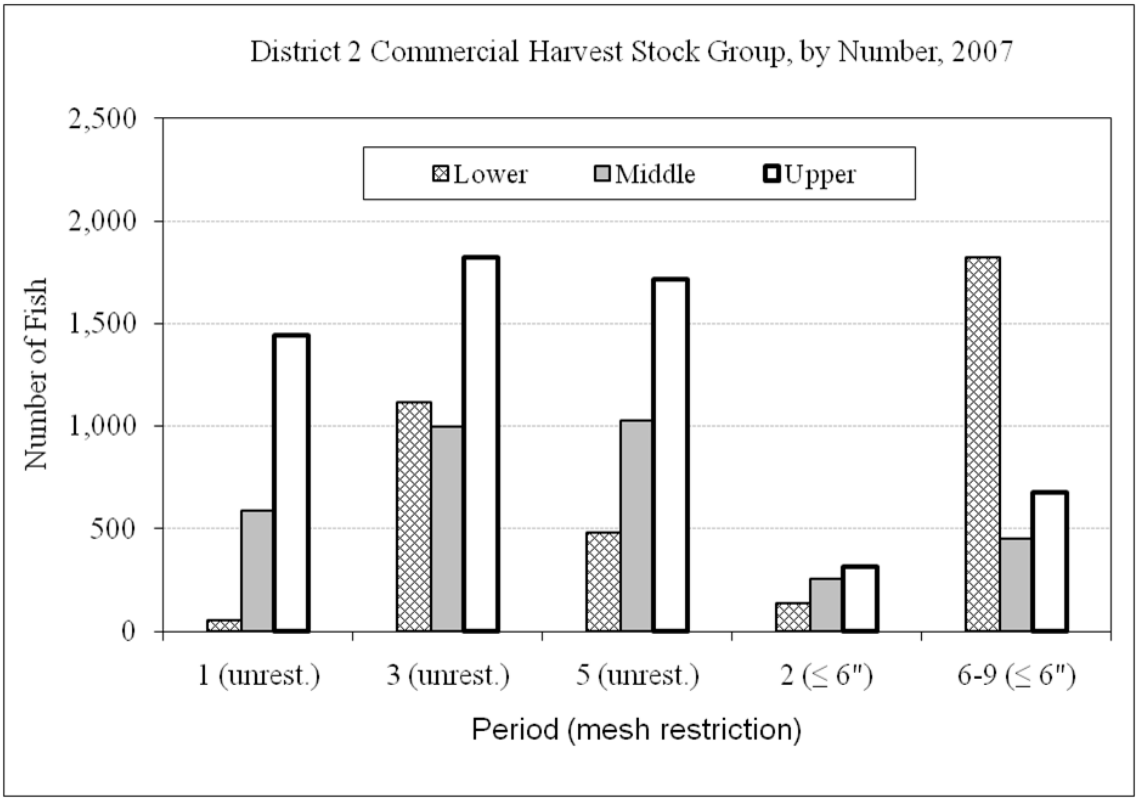
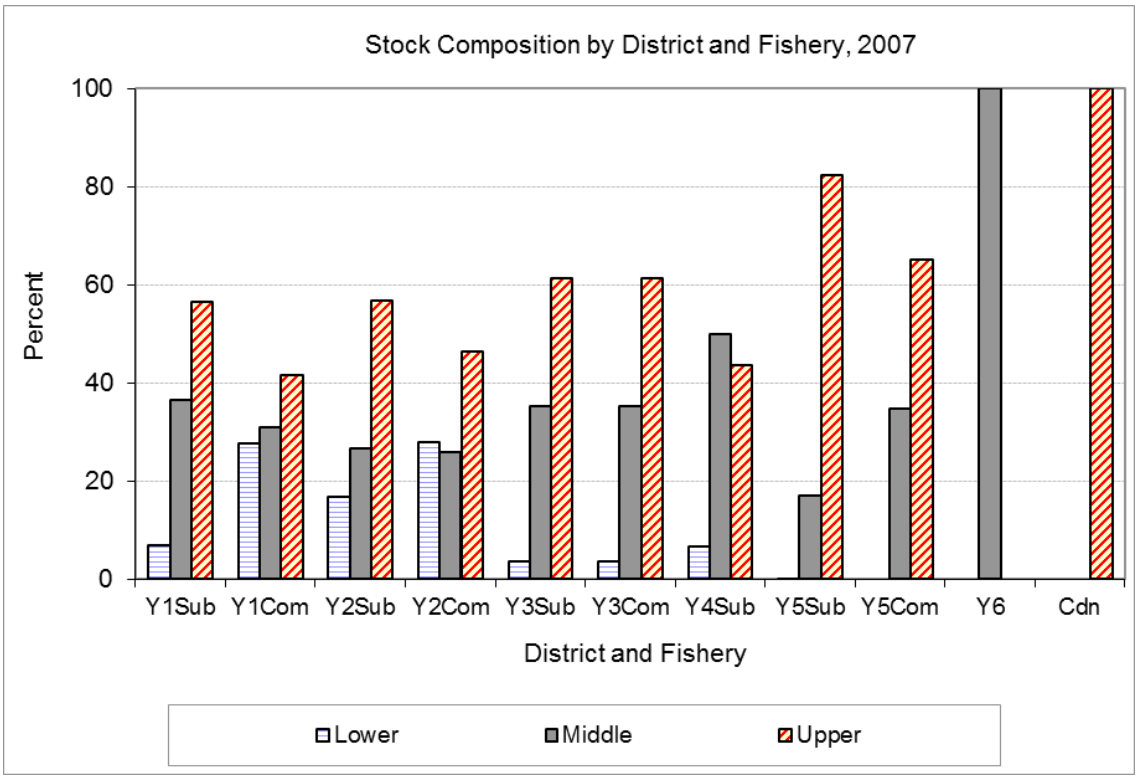


Figure 4.–Genetic stock composition from Yukon River District 2 commercial harvest periods, by percentage (upper) and number (lower), 2007.



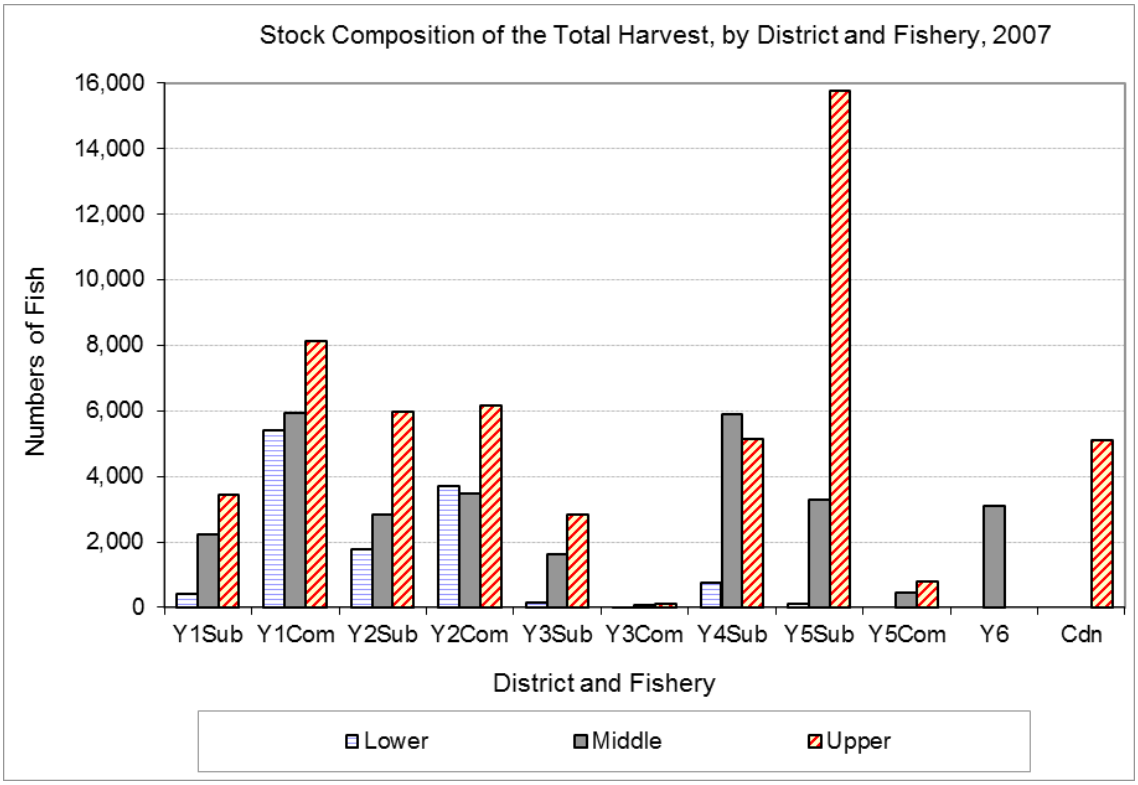


Figure 5.–Genetic stock composition from Yukon River harvests, by district and fishery, by percentage (upper) and number (lower), 2007.